these lines, upwards positive, downwards negative, are the *co-ordinates* of the straight line *MN*. So much for the *parallel* co-ordinates. Take a straight line, *Ox*, for *axis*, and on this line a point, *O*, the *pole* of the system. A straight line is determined by the angle θ, which it makes with the axis, and by the length λ from *O* of its intersection with *Ox*. These are the *axial* co-ordinates. Elementary details of these two systems are given for the former in Chapters I.-V. (pp. 1-33); for the latter, in Chapters VI.-VIII. (pp. 36-43). Several applications to examples are discussed. Chapters IX., X. (pp. 52-73) are devoted to a "Méthode de transformation géométrique fondée sur la simple comparaison des coordonnées parallèles avec les coordonnées rectangulaires." The "procédé nouveau" is the closing portion of this chapter (pp. 73-82).

The illustrations in the pamphlet are mostly taken from curves of the second degree, but these co-ordinates—a kind of tangential co-ordinates—are useful for such questions as the following:—Find a curve such that a portion of a tangent intercepted between the point of contact and the axis has a constant length (the tractrix is such that the area between it and the axis is equal the area of a semi-circle, radius equal distance from origin to cusp of tractrix); find a curve such that the portion of a perpendicular *TI* to the axis *Ox* drawn through the foot *T* of the tangent, limited on one side by *Ox* and on the other by the corresponding normal, has a given length (the curve, of course, is readily seen to be a cycloid).

The pamphlet is an interesting one, and suggests methods of procedure which in some cases have advantages over other methods more familiar.

LETTERS TO THE EDITOR

[The Editor does not hold himself responsible for opinions expressed by his correspondents. Neither can he undertake to return, or to correspond with the writers of, rejected manuscripts. No notice is taken of anonymous communications.

[The Editor urgently requests correspondents to keep their letters as short as possible. The pressure on his space is so great that it is impossible otherwise to insure the appearance even of communications containing interesting and novel facts.]

The Colours of Arctic Animals

I AM sorry that I cannot agree with my friend Mr. Meldola as to the insufficiency of the explanation of the white coloration of Arctic mammals and birds as due to protective adaptation, since it appears to me that there is no important group of facts in natural history of which the explanation is more complete; while on the other hand I venture (though with some hesitation) to question the basis of his counter explanation, as I am not aware of any sufficient proof that colour, *per se*, affects the radiation of low grade heat. At all events I feel tolerably certain that this cause, if it exists, has had no perceptible influence in determining the white colours of Arctic animals.

I am not myself aware of there being "many species" possessing the white coloration as to which there is any difficulty in seeing the advantage they may derive from it, and there is certainly a large body of facts showing that *colour* is, in almost all animals and in every part of the world, more or less protective or adaptive. If the white coloration of Arctic animals stood alone, it might be thought necessary to supplement the protective theory by any available physical explanation, but we have to take account of the parallel cases of the sand-coloured desert animals and the green-coloured denizens of the ever-verdant tropical forests; and though in both these regions there are numerous exceptional cases, we can almost always see the reason of these, either in the absence of the need of protection or in the greater importance of conspicuous colouring. In the Arctic regions these exceptions are particularly instructive because in almost every case the reason of them is obvious. Let me call attention to a few which now occur to me.

In the Arctic zone the wolf does not turn white like the fox, the reason evidently being that he hunts in packs, and concealment from his prey is not needed. So the musk-sheep and the yak, though both exposed to the extremest cold, are not white, because they are both swift and strong and need no concealment from their enemies. For the same reason neither the moose, the caribou, nor the reindeer are wholly white. Again, the glutton and the sable are dark-coloured, though inhabiting the coldest regions, and this is clearly because they are arboreal, and are better concealed from their prey by a dark than a light colour. If any useful protection from cold were to be obtained by a white coat, we should expect it to appear in such a case as the Esquimaux dogs, exposed for countless generations to the severest climate. But they gained the required warmth by a thickening of the woolly undercoat in winter, as do many other animals; and this suggests the general proposition that it will be always easier and safer to gain warmth in this way than by a modification of colour, which could certainly have but a very small effect, and might often interfere with adaptations of far greater importance. Exactly analogous cases occur among birds. The raven is, perhaps, the extremest Arctic species, but, feeding on carrion, it has no need of concealment in approaching its prey, and thus it keeps its jet black coat in the depths of the Polar winter.

The physical explanation of melanism in butterflies and some other insects, on the other hand, seems to me to be probably a sound one; but even that requires more evidence and a fuller knowledge of the habits of the species before we can admit it as proved. It may be that the dark colouring is protective, assimilating with the surroundings of the insect when at rest, and this can only be decided by observations specially directed to the point in question.

But even if, in this case, the dark colour has been produced in order to favour the absorption of the direct rays of the northern sun, it affords no support whatever to the totally different case in which the radiation of the obscure heat from an animal body has to be checked. I may, perhaps, be ignorant on the point, as it is rather out of my line, but I am not aware of any good experiments to determine the influence of colour *per se*, as distinct from the structure and surface-texture of coloured substances, on the radiation or absorption of heat of a low grade of temperature, and from a dark source. The only authority I have at hand (Ganot's "Physics," eighth edition) seems rather to imply that colour has no effect in such cases, for I find it stated, at p. 338, that the radiating power of *lampblack* and *whitelead* are identical, both being given as 100, while *Indian ink* is only 88. Again, at p. 352, the absorptive power of these two substances is given as 100, the source of heat being copper at 100° C., while that of Indian ink is given as 85. This seems to show that surface-texture or molecular structure is the important point, while colour has no effect whatever.

In order to determine experimentally whether white fur or feathers are inferior to black as radiators of animal heat, it would not do to employ stained or dyed materials, because the pigments employed might affect the texture of the surface, and produce an effect not at all due to the colour. A fair test would be afforded by two samples of cloth or flannel woven from white and black natural wool respectively, the wool to be obtained from the same breed of sheep, and, if possible, from the same district, while the material must be as nearly as possible identical in weight and texture. I shall be glad to learn from Mr. Meldola, or any other of your readers, whether any experiment of this kind has been made, or whether there is any valid reason for believing that the radiation of animal heat is at all affected by colour alone.

ALFRED R. WALLACE

Civilisation and Eyesight

THE statistics of eyesight given by Mr. H. B. Guppy in NATURE (p. 503) relating to the inhabitants of the Solomon Islands as tested by the Army test-dots, bring us nearer, I think, to the solution of the question of the relative acuteness of vision of civilised and savage races than any previous communication which has appeared in your columns, as we are able to compare them with statistics obtained under similar conditions in this country. The Anthropometric Committee of the British Association gave a series of tables in their Report for 1881 showing the results of their inquiries into the sight of different classes of the community, carried out by means of the Army test-dots; and for the purpose of comparison with Mr. Guppy's figures I have extracted the returns relating to men employed in agriculture and other out-door occupations as most nearly agreeing with the conditions of life of savage people, and have embodied them, together with Mr. Guppy's, in the following table:—

Distance in feet at which the Army test-dots were distinguished	English agricultural and out-door labourers, age 16 to 45 years. No. of obs.	Solomon Islanders, age not stated. No. of obs.	English agricultural labourers, &c., age 21 years. No. of obs.
5 to 10	1	—	—
10—15	1	—	—
15—20	4	—	1
20—25	8	—	1
25—30	15	—	1
30—35	29	—	2
35—40	34	1	3
40—45	27	0	3
45—50	40	0	8
50—55	55 *	7 *	11 *
55—60	52	2	8
60—65	40	7	4
65—70	40	3	2
70—75	20	2	2
75—80	9	—	1
80—85	3	—	1
85—90	2	—	—
90—	5	—	1
Total	385	22	49
Average	52·1	57·5	52·5
Mean	55·0	55·0	52·5

* Mean or value of greatest frequency.

Mr. Guppy's figures are too few in number, and too irregular in their relation to each other and to the columns of figures on either side of them, to be accepted as representative of the range of vision of the Solomon Islanders, and he must have stumbled on some of the better examples, or else the short-sighted men have not presented themselves to him for examination. Nevertheless, taking the figures as they stand, they give no support to the belief that savages possess better sight than civilised peoples. Mr. Guppy gives 60 feet as the distance at which the test-dots were distinguished, but the average of his figures is 57·5 feet, or only half a foot more than Prof. Longmore worked out, from observations on British recruits, as the distance which the test-dots ought to be seen in good daylight. Judging from the run of the figures, I should place the so-called "normal" vision of the Solomon Islanders at 55 feet, or possibly at 52·5 feet, like the English labouring classes of the age of twenty-one years, as our figures representing that age are remarkably uniform in their distribution, and therefore near the truth. The average of the Solomon Islanders is, it is true, higher by 5 feet than the English in my table; but this is obviously due to the absence of observations on the less perfect-sighted individuals belonging to the former race. Even when the test is one of seeing objects at the greatest distance, the best savages are inferior to the best English by about one-third. Mr. Guppy evidently believes that the Solomon Islanders possess very superior sight compared with ourselves, especially for distant object; and Mr. J. A. Duffield, who read a paper recently, at the Anthropological Institute, on the natives of some adjoining islands, was still more firmly of this opinion; but it is obvious that the question cannot be decided by general impressions, nor by the result of comparisons with sight the value of which we are ignorant. Travellers naturally record cases in which their own sight (which they believe to be good, but which may be very bad) is outstripped by savages, but do not encumber their pages with negative evidence of the kind. Their mistake lies in confounding acuteness of vision with the results of special training or education of the faculty of seeing—results quite as much dependent on mental training as on the use of the eyes.

Bolton Row, Mayfair, April 13 CHARLES ROBERTS

Far-sightedness

ALLOW me to corroborate the report of your correspondent, whose letter appears in NATURE of April 2 (p. 506) as to the visibility of very distant terrestrial objects. In the spring of 1837 I was travelling from Rome, northwards, by "Vetturino," and from the summit of the Apennine on the road between Florence and Bologne, I saw, with astonishment, the whole range of the Swiss Alps, not merely distinguishable but conspicuous. Measured on the map in a direct line the nearest part of the range was distant about 200 miles. The extreme portions, including Mont Blanc, were considerably more. I have no doubt that the atmospheric conditions were unusually favourable. For when I asked the Vetturino what mountains they were, he, having often passed that way without seeing them, said they were nothing but clouds. I told him that I knew a snow mountain when I saw it; and as a peasant, living on the spot, shortly passed, I renewed my inquiry—to which he immediately answered, to my surprise, that they were the mountains of Switzerland. J. HIPPISLEY

Stoneaston, April 7

ON September 3, 1874, from the Piz Muraun, near Dissentis, I saw the white dome of Mont Blanc, distant about 110 English miles. As the Piz Muraun is only about 9500 feet I was sceptical, till a reference to maps showed a line of intervening depressions. I feel sure that some Alpine tourists will be able to furnish Herr Metzger with cases of mountains identified at distances vastly exceeding this of mine. E. HILL

Cambridge, April 8

The Pupil of the Eyes during Emotion

IN connection with the above subject the following experiment may be of interest to your readers. It is one I made many years ago when studying the border-land between physiology and psychology. At that time I showed and explained it to a number of my friends.

In this experiment it appears to the observer as if I had control over the muscles of the iris, as I can make the pupil of the eye large or small at will. Placing myself in front of, and looking towards, a window or other bright light, the observer is desired to watch the pupil, and say when to contract or expand it. On the order being given, the pupil is seen to expand or contract as desired. This experiment can be easily made by any one in the following manner:—The eye is directed towards the light and a point looked at, the eye being kept steady during the whole experiment. Under these conditions the bright light causes the pupil to contract automatically, and when desired to expand it all that is necessary is to take the attention away from the eye and fix it on some other part of the body—say, by biting the tongue, pinching the arm, &c. By these means the sensitiveness of the retina is, for well-known reasons, reduced, and the pupil automatically dilates. To cause it again to contract, the mind has simply to be recalled to the eye and attention given to the visual impressions.

This experiment supports the explanation given by Dr. Herdman in Mr. Clark's letter in NATURE, vol. xxxi. p. 433, and also the explanation given by Dr. Wilks at p. 458. When the mind is under the influence of fear, the energies are diverted from the eyes and the pupils dilate on account of the reduced sensitiveness of the retina. While in anger, sight being powerfully called into action, the sensitiveness of the retina is increased and the pupil automatically contracts, so that generally we might expect that during those emotions in which the eyes are called into action the pupils will be small, and that when the nervous energies are directed away from the eyes to other centres, the pupils will be large. JOHN AITKEN

Torquay, April 8

Notes on the Geology of the Pescadores

DURING a stay of two days in Makung Harbour in 1877, I collected a few notes on the geology of this small group, which has, from its recent occupation by the French, been brought before the notice of the public. These islands, which were briefly described in the last number of NATURE (p. 540), have a characteristic appearance, being flat-topped, 100 to 200 feet in height, and presenting a rather barren aspect from the scarcity of trees and shrubs. Dampier, who visited them in 1687, described them as "much like our Dorsetshire and Wiltshire Downs," producing "thick, short grass and a few trees," a description equally applicable at the present day.

As far as I could ascertain, the whole group was of basaltic formation, the columnar structure being well developed, columns 30 to 40 feet high being observable in the faces of some of the cliffs. In the places I visited the cliffs were built up of two basaltic streams superimposed, the two masses towards their junction being scoriaceous and amygdaloidal, and separated by a layer three inches thick of a red, soft rock or laterite. The